ORIGINAL PAPER

Nagoya J. Med. Sci. **79**. 157 ~ 165, 2017
doi:10.18999/nagjms.79.2.157

Disparity in metabolic risk factors of non-communicable diseases between Palauans and Filipinos living in Palau

Ayaka Osako[1], Chifa Chiang[1]*, Kana Ito[1], Hiroshi Yatsuya[1,2], Esayas Haregot Hilawe[1], Edolem Ikerdeu[3], Kaori Honjo[4], Takashi Mita[5], Renzhe Cui[4], Yoshihisa Hirakawa[1], Sherilynn Madraisau[3], Gregorio Ngirmang[3], Hiroyasu Iso[4] and Atsuko Aoyama[1]

[1]*Department of Public Health and Health Systems, Nagoya University School of Medicine, Nagoya, Japan*
[2]*Department of Public Health, Fujita Health University School of Medicine, Toyoake, Aichi, Japan*
[3]*Ministry of Health, Republic of Palau, Koror, Palau*
[4]*Public Health, Graduate School of Medicine, Osaka University, Suita, Osaka, Japan*
[5]*Institute of Academic Initiatives, Osaka University, Suita, Osaka, Japan*

ABSTRACT

Non-communicable diseases have been recognized as a serious threat to public health in Palau. To tackle the problem, different strategies might be necessary for populations with different ethnic backgrounds. This study aims to find the differences in the prevalence of metabolic risk factors of non-communicable diseases between Palauans and Filipinos living in Palau, and examine possible determinants of the differences. We selected data of 2,032 participants, including native Palauans and Filipinos, from the Palau STEPS Survey 2011–2013 for this study. Logistic regression models were used to inspect the association of each metabolic risk factor with ethnicity by calculating odds ratios adjusted for potential confounding factors. Palauans had higher age-standardized prevalence of overweight or obesity (84% vs. 45%), hypertension (50% vs. 38%) and diabetes (19% vs. 13%) than Filipinos. However, after adjusting for BMI and various lifestyle related factors, there are no statistical significant differences in the prevalence of hypertension and diabetes between these two ethnic groups. Palauan men were less likely to have elevated total cholesterol, especially after adjusting for BMI (odds ratio=0.55, 95% confidence interval: 0.33–0.91), while Palauan women were more likely to have elevated triglycerides than their Filipino counterparts (odds ratio=1.45, 95% confidence interval: 1.02–2.06). Our findings suggested that Palauans' higher BMI distribution might be able to explain their higher prevalence of hypertension and partially explain their higher diabetes prevalence. Palauans were not consistently more likely to have all metabolic risk factors, namely dyslipidemia were less likely to be observed in Palauan men.

Key Words: metabolic risk factors, ethnic groups, Asian, Pacific Islander, WHO STEPS

INTRODUCTION

Non-communicable diseases (NCDs) have been recognized as a serious threat to public health in the Pacific Islands, which account for approximately 70 to 75% of all deaths.[1)] More

Received: September 21, 2016; accepted: March 21, 2017

Corresponding Author: Chifa Chiang, PhD
Department of Public Health and Health Systems, Nagoya University School of Medicine, 65 Tsurumai-cho, Showa-ku, Nagoya 466-8550, Japan
Email: keihatsu@med.nagoya-u.ac.jp

importantly, many of these NCD related deaths are premature (before age 60 years) and are preventable. The Republic of Palau is no exception; the 2012 national mortality data reported by the Ministry of Health revealed that more than one third of the death toll was attributed to cardiovascular disease and one seventh to diabetes.[2)]

In an attempt to describe the burden of NCDs in Palau, the Ministry of Health launched a nationwide survey for NCD risk factors (STEPwise approach to surveillance: STEPS) in 2011 in collaboration with the World Health Organization (WHO). A very high prevalence of the NCD risk factors was reported from it: *e.g.*, more than two in three adults in Palau were overweight or obese, and more than half of them were hypertensive.[3)]

Palau has heavily relied on overseas workers for its domestic workforce, especially from the neighboring Philippines, since its independence in 1994. Besides native Palauans, about 30% of the total population of about 20,000 in this island country are non-Palauan residents. However, prevalence of NCD risk factors according to different ethnicities in Palau has not yet been described in detail. For planning and implementing effective public health measures to prevent and control NCDs for the whole population, describing and understanding attributes of differences in the prevalence of NCD risk factors among different ethnicities in Palau would be useful.

This study aims to identify differences in the prevalence of metabolic risk factors of NCDs between the two major ethnic groups in Palau, namely native Palauans and Filipinos, and to examine possible explanations for the observed differences.

METHODS

We conducted a cross-sectional study by analyzing the data of the Palau STEPS Survey 2011–2013, of which the data collection had been carried out between September 2011 and June 2013. The study design and methods of the first national STEPS survey in Palau have been described elsewhere in detail[3] and outlined as in the following. A population representative data was obtained by adopting the WHO STEPS Instrument and targeted at residents aged 25 to 64 years in Palau. A total of 2,212 individuals had completed all three steps of the survey, including a questionnaire based interview, physical measurements, and blood tests.

For the purpose of the current study, we selected 2,032 subjects from the original dataset by applying the following exclusion criteria: those who were not Palauan or Filipino (n=156), who were not within the target age range of 25–64 years (n=12), whose sexes were not reported (n=2), and who were pregnant at the moment of the survey (n=28).

Data from the physical measurements and blood tests were categorized for the subsequent statistical analyses based on existing criteria, as described below. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. A BMI between 25 and 29.9 kg/m^2 was defined as overweight, and equal to or higher than 30 kg/m^2 was defined as obesity, according to the WHO criteria.[4)] Since there were three readings of blood pressure available for each participant in the dataset, we calculated an arithmetic mean of the last two readings for the following categorization. Hypertension was defined as people with a systolic blood pressure (SBP) ≥140 mmHg or a diastolic blood pressure (DBP) ≥90 mmHg, or a self-reported use of antihypertensive medication.[5)] In accordance with WHO criteria, fasting blood glucose ≥126 mg/dL or those on diabetes treatment were defined as diabetes.[6)] Regarding blood lipids, blood levels of total cholesterol ≥200 mg/dL or those on cholesterol-lowering medication were defined as ‘elevated total cholesterol’ and fasting blood levels of triglycerides ≥150 mg/dL as ‘elevated triglycerides’. Both of these two criteria above are presented in the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Education, and Treatment

of High Blood Cholesterol in Adults (NCEP ATP III) as 'borderline-high to high' levels of total cholesterol and triglycerides.[7)]

To examine the differences in characteristics between Palauans and Filipinos, the Student's t-test and chi-squared test were used as appropriate. Analysis of covariance (ANCOVA) was applied to compare mean values of each physical or biochemical factor adjusted for age. Both crude and adjusted odds ratios of having metabolic risk factors of NCDs, namely overweight, obesity, hypertension, diabetes, elevated total cholesterol, and elevated triglycerides, in Palauans compared with Filipinos were calculated by using logistic regression models. Considering that men and women are always different in terms of NCD risk factors, we stratified the aforementioned analyses by sex. All reported p values in this study were two-sided, and those less than 0.05 were considered to be statistically significant. The statistical software, IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp, Armonk, NY, USA) was used for all of the data analysis.

RESULTS

About 80% of the selected participants for this study were Palauan (751 men and 875 women) with a mean age of 46.6 years (standard deviation=10.22 years), and 20 % were Filipino (200 men and 206 women) with a mean age of 42.3 years (standard deviation=9.46 years). As demonstrated in Table 1, the mean BMI for Palauan men and women were 30.8 kg/m^2 and 31.4 kg/m^2, and for Filipino men and women were 25.3 kg/m^2 and 24.6 kg/m^2, respectively. In addition to the differences in mean BMI, Palauans also had significantly higher mean DBP in both sexes. Filipinos had higher mean total cholesterol levels than Palauans in both sexes. No significant differences were shown in the mean SBP between the two ethnic groups in both sexes, whereas Palauan women had higher mean levels of fasting glucose and triglycerides than their Filipino counterparts.

Table 2 shows the association between each of the metabolic risk factors and ethnicity by logistic regression. In both sexes, Palauans were much more likely to be overweight or obese independent of age and various potential confounding factors, *i.e.* income level, educational attainment, place of residence, fruit and vegetable intake, alcohol drinking, and tobacco product use; with multivariable adjusted odds ratios of 7.53 and 7.21 in men and women, respectively (both $p<0.001$). It is generally known that obesity strongly associated with metabolic complications such as hypertension, diabetes, and dyslipidemia; thus, BMI adjustment was also performed to examine their associations with ethnicity. Palauans had significantly higher prevalence of hypertension compared with Filipinos in both sexes; the significant differences of hypertension across ethnicity were attenuated after adjusting for age, BMI and other factors. Although Palauan men were more likely to have diabetes (odds ratio=1.34, $p=0.203$) and less likely to have elevated total cholesterol (odds ratio=0.67, $p=0.089$) compared with Filipino men in age-adjusted models, the associations were not statistically significant. Palauan women had a significantly higher prevalence of diabetes and elevated fasting triglycerides compared with Filipino women in age-adjusted models; however, the statistical significance was not shown after further adjusting for BMI or other potential confounding factors.

Table 1. Characteristics of Palauans and Filipinos aged 25–64 years in the Palau STEPS Survey 2011–2013

	Men			Women			Both Sexes		
	Palauan	Filipino	*p* value	Palauan	Filipino	*p* value	Palauan	Filipino	*p* value
N	751	200		875	206		1626	406	
Mean age in years (SE)	46.7 (0.37)	42.1 (0.66)	< 0.001	46.5 (0.35)	42.6 (0.67)	< 0.001	46.6 (0.25)	42.3 (0.47)	< 0.001
Age group (years), %			< 0.001			< 0.001			< 0.001
25–34	13.8	25.5		14.7	23.8		14.3	24.6	
35–44	26.1	33.0		26.9	31.6		26.5	32.3	
45–54	32.6	28.0		32.9	32.0		32.8	30.0	
55–64	27.4	13.5		25.5	12.6		26.4	13.1	
Place of residence, %			< 0.001			< 0.001			< 0.001
Koror	55.7	77.5		60.1	78.6		58.1	78.1	
non-Koror	44.3	22.5		39.9	21.4		41.9	21.9	
Educational attainment, %			0.034			0.145			0.008
< primary school	3.3	2.6		3.0	3.4		3.2	3.0	
primary school	15.7	8.2		12.3	6.9		13.9	7.5	
secondary school	42.0	42.9		37.9	42.6		39.8	42.8	
≥ college	39.0	46.4		46.8	47.1		43.2	46.8	
Monthly household income per adult (USD), %			0.001			< 0.001			< 0.001
< 250	29.7	27.6		28.1	47.0		28.9	37.2	
250–499	29.3	43.2		26.9	35.4		28.0	39.3	
≥ 500	41.0	29.2		45.0	17.7		43.1	23.5	
Lifestyle factors, %									
Alcohol drinking			0.013			0.009			0.005
< 1 day per month	55.9	60.5		80.8	90.8		69.3	75.9	
1–3 days per month	17.4	19.5		12.2	5.8		14.6	12.6	
1–4 days per week	16.2	17.0		4.2	1.9		9.8	9.4	
≥ 5 days per week	10.4	3.0		2.7	1.5		6.3	2.2	
Tobacco smoking			< 0.001			< 0.001			< 0.001
non-smoker	41.5	48.0		56.0	84.0		49.3	66.3	
ex-smoker	37.2	18.0		34.1	9.2		35.5	13.5	
non-daily smoker	3.5	4.0		2.9	1.9		3.1	3.0	
daily smoker	17.8	43.0		7.1	4.9		12.1	17.2	
Chewing betel nut with tobacco			< 0.001			< 0.001			< 0.001
non-chewer	42.3	97.5		31.4	98.5		36.5	98.0	
chewer	57.7	2.5		68.8	1.5		63.5	2.0	
Any form of tobacco use			< 0.001			< 0.001			< 0.001
non-user	31.4	64.0		28.1	91.7		29.6	78.1	
user	68.6	36.0		71.9	8.3		70.4	21.9	
Fruit intake, days/week			< 0.001			< 0.001			< 0.001
none	25.0	9.6		17.0	5.3		20.7	7.4	
1–2	40.3	39.4		36.8	39.3		38.4	39.4	
3–5	20.9	28.3		26.9	27.2		24.2	27.7	
6–7	13.8	22.7		19.3	28.2		16.8	25.5	

Vegetable intake, days/week			< 0.001			< 0.001			< 0.001
none	5.5	1.0		3.1	1.5		4.2	1.2	
1–2	27.0	18.6		18.6	8.7		22.5	13.6	
3–5	36.2	33.7		38.3	29.1		37.3	31.4	
6–7	31.3	46.7		40.0	60.7		36.0	53.8	
Physical and biochemical factors, age-adjusted mean (SE)									
Body Mass Index, kg/m^2	30.8 (0.21)	25.3 (0.41)	< 0.001	31.4 (0.21)	24.6 (0.43)	< 0.001	31.1 (0.15)	25.0 (0.30)	< 0.001
Systolic blood pressure, mmHg	142.9 (0.70)	140.6 (1.37)	0.139	138.7 (0.74)	136.1 (1.53)	0.118	140.6 (0.52)	138.4 (1.05)	0.061
Diastolic blood pressure, mmHg	87.3 (0.45)	84.5 (0.88)	0.006	84.9 (0.43)	81.0 (0.88)	< 0.001	86.0 (0.31)	82.8 (0.63)	< 0.001
Fasting blood glucose, mg/dL	119.3 (1.47)	112.9 (2.94)	0.052	118.1 (1.57)	109.9 (3.20)	0.023	118.7 (1.08)	111.4 (2.18)	0.003
Total cholesterol, mg/dL	142.6 (2.51)	156.1 (4.98)	0.016	145.5 (2.41)	159.8 (4.91)	0.009	144.1 (1.74)	158.3 (3.50)	< 0.001
Fasting triglycerides, mg/dL	182.2 (4.33)	180.6 (8.72)	0.867	170.6 (3.66)	151.8 (7.58)	0.026	165.7 (5.75)	175.9 (2.81)	0.110

Abbreviation: SE, standard error; USD, United States dollars

Table 2. Odds ratios of metabolic risk factors derived from logistic regression models (Filipino as reference)

			Crude		Model 1		Model 2	Model 3	Model 4
			OR (95% CI)	%	OR (95% CI)	%[a)]	OR (95% CI)	OR (95% CI)	OR (95% CI)
Men	Overweight or obesity, BMI ≥ 25 kg/m^2	P	4.89** (3.47–6.88)	84.1	4.70** (3.32–6.66)	83.4	–	–	7.53** (4.80–11.83)
		F	1	52.0	1	51.4			1
	Obesity	P	10.42** (6.28–17.27)	51.0	10.90** (6.54–18.17)	51.7	–	–	14.22** (7.89–25.63)
		F	1	9.1	1	8.6			1
	Hypertension	P	1.79** (1.31–2.45)	59.9	1.51* (1.09–2.08)	53.8	1.07 (0.75–1.53)	0.99 (0.65–1.52)	1.64* (1.12–2.40)
		F	1	45.5	1	43.2	1	1	1
	Diabetes	P	1.61* (1.03–2.50)	24.0	1.34 (0.85–2.11)	20.4	0.86 (0.52–1.41)	0.76 (0.43–1.34)	1.18 (0.70–1.97)
		F	1	16.4	1	14.5	1	1	1
	Elevated total cholesterol	P	0.82 (0.52–1.28)	14.9	0.67 (0.42–1.06)	11.5	0.55* (0.33–0.91)	0.53* (0.29–0.96)	0.68 (0.40–1.17)
		F	1	17.6	1	17.3	1	1	1
	Elevated triglycerides	P	1.05 (0.74–1.48)	49.1	0.99 (0.69–1.41)	47.5	0.69 (0.47–1.01)	0.57* (0.36–0.91)	0.85 (0.56–1.28)
		F	1	47.8	1	43.9	1	1	1
Women	Overweight or obesity, BMI ≥ 25 kg/m^2	P	8.92** (6.35–12.55)	86.0	8.29** (5.88–11.70)	84.9	–	–	7.27** (4.39–12.05)
		F	1	40.8	1	39.6			1
	Obesity	P	10.96** (6.78–17.73)	54.8	10.85** (6.69–17.60)	54.7	–	–	8.99** (5.10–15.85)
		F	1	10.0	1	9.8			1

Hypertension	P	2.23** (1.62–3.07)	53.5	1.84** (1.32–2.57)	46.2	1.28 (0.88–1.86)	1.49 (0.91–2.42)	2.14** (1.35–3.38)
	F	1	34.0	1	32.5	1	1	1
Diabetes	P	2.17** (1.35–3.50)	22.9	1.80* (1.10–2.93)	18.3	1.35 (0.80–2.27)	1.11 (0.57–2.17)	1.54 (0.82–2.90)
	F	1	12.0	1	11.4	1	1	1
Elevated total cholesterol	P	1.24 (0.82–1.89)	20.7	0.96 (0.62–1.49)	16.2	1.07 (0.66–1.73)	0.90 (0.48–1.70)	0.91 (0.50–1.66)
	F	1	17.4	1	16.1	1	1	1
Elevated triglycerides	P	1.58** (1.12–2.24)	44.2	1.45* (1.02–2.06)	41.1	1.06 (0.72–1.57)	0.70 (0.42–1.16)	0.96 (0.60–1.55)
	F	1	33.3	1	32.1	1	1	1

Abbreviation: OR, odds ratio; CI, confidence interval; BMI, body mass index; P, Palauan; F, Filipino
*$p < 0.05$, **$p < 0.01$

[a)] Age-adjusted prevalence, using the national population of Palau as a standard based on 2005 Census of Population & Housing

Model 1: adjusted for age (continuous); Model 2: adjusted for age and BMI (continuous); Model 3: adjusted for age, BMI, income level (categorical), education level (categorical), place of residence (Koror or non-Koror), fruit intake (continuous), vegetable intake (continuous), alcohol drinking (categorical), and tobacco product use (user or non-user); Model 4: adjusted for age, income level, education level, place of residence, fruit intake, vegetable intake, alcohol drinking, and tobacco product use. The categorizations in Table 1 were used for income level, education level and alcohol drinking.

DISCUSSION

Our findings showed that Palauans were significantly more likely to be overweight or obese than Filipinos in both sexes, even after adjusting for age and other potential confounding factors. Palauans were also more likely to have hypertension, although the associations were not statistically significant after adjusting for BMI. Higher prevalence of diabetes in Palauans was not significant after adjusting for BMI or various lifestyle related factors. Regarding dyslipidemia, Palauan men were less likely to have elevated total cholesterol, while Palauan women were more likely to have elevated fasting triglycerides compared with their Filipino counterparts.

Apart from some studies conducted in the United States, very few studies comparing metabolic risk factors of NCDs among ethnic Asians and Pacific islanders were reported. A previous study conducted in Fiji showed that indigenous Fijians had higher rates of obesity (17% vs. 11%) and hypertension (21% vs. 16%), but lower rates of diabetes mellitus (12% vs. 21%) and high total cholesterol (33% vs. 39%), compared with Indo-Fijians.[8)] However, it did not examine what could possibly explain such differences between the two ethnicities. In the current study, we have not only revealed inter-ethnicity differences in the prevalence of those NCD risk factors, but found that the distinct difference in BMI distribution between Filipinos (Asians) and Palauans (Pacific Islanders) could explain the significant differences in the prevalence of hypertension in both sexes, as BMI-adjusted logistic regression models did not indicate independent association of the prevalence with ethnicity. Our study findings indicated that the higher obesity prevalence in Palauans would be the major explanation for their higher prevalence of hypertension in both sexes. Higher prevalence of diabetes in Palauans might be partly related to the differences of BMI distribution and partly related to lifestyles across ethnicity, as the statistical significance attenuated in the Model 2 (BMI adjusted) and Model 4 (BMI non-adjusted). Men and women

might have different trends in terms of comparing dyslipidemia prevalence between two ethnic groups, namely a lower prevalence of elevated total cholesterol in Palauan men and a higher prevalence of elevated fasting triglycerides in Palauan women compared with Filipinos.

In general, NCDs and their common metabolic risk factors are known to be caused by complex interaction of: (1) genetic factors, (2) lifestyle related factors, and (3) environmental/external factors.[9] In this study, we considered that Palauans and Filipinos generally shared common environmental/external factors, as both are living in Palau and having equal access to foods, health services, and other social systems. Thus, the differences between the two ethnic groups are likely to be related to (1) genetic factors and (2) lifestyle related factors.

Several studies reported that particular genotypes, which might contribute to obesity, were overrepresented in Pacific Islanders, especially Palauans, compared with Asian populations.[10,11] The current study revealed that obesity prevalence in Palauans was significantly higher than in Filipinos independent of several lifestyle related factors, indicating the genetic determinants, for the most part, might explain the higher obesity prevalence among Palauans. Although our findings seemed to be consistent with those from previous studies, it still remains unclear as the genotypes have not been inspected among Filipino population yet.

In addition, traditional values might contribute to increased obesity among Palauans. Since people do not have a negative perception of obesity-sized bodies in some Pacific countries,[12,13] Palauans might be more tolerant to become overweight or obesity than Filipinos. Further studies to investigate how Palauans' body image contributes to differences in overweight or obesity compared with other ethnic groups are warranted.

To date, most of the Pacific island countries and territories (PICT) have completed their STEPS surveys for NCD risk factors. In comparison with their results, Palau had the highest age-standardized prevalence of hypertension in both men and women, although its prevalence of obesity was much lower than many other PICTs.[14] Findings of the current study showed not only native Palauans but Filipinos also have relatively high prevalence of hypertension compared with those national data from PICTs. Although data was not available, both Palauans and Filipinos living in Palau might have similar lifestyles related to the increased hypertension, such as high sodium intakes. It was reported that many gene mutations which associated with hypertension have been found to be more frequent in Asian populations.[15] A study conducted in the United States found that Filipinos had highest prevalence of hypertension (27%) among Asian Americans.[16] Filipino Americans were also most likely to have ever been told they have hypertension (27%) compared with other ethnic Asian groups in a national survey.[17] Our findings suggested the prevalence difference between Palauans and Filipinos might be mainly caused by Palauans' high prevalence of obesity rather than lifestyles or other factors. It indicates the possibility that Palauans and Filipinos have close genotypes in terms of hypertension, compared with other populations in PICTs. Study designs with genetic typing might be necessary to examine this hypothesis.

The findings of the current study demonstrated that Palauan men were less likely to be dyslipidemia than Filipino men, especially after adjusting for BMI and other lifestyle related factors. However, the result was not consistent with that from the comparison in women, as Palauan women were significantly more likely to have elevated triglycerides than Filipino women in the age-adjusted logistic regression model. It has already been know that men and women have different risks of dyslipidemia, and the risks are strongly associated with estrogen changes in women. It was also reported that dyslipidemia related genotype frequency is different across gender and ethnicity.[18] Apart from dyslipidemia, Palauans were likely to have metabolic risk factors of NCDs, namely overweight or obesity, hypertension, and diabetes in both sexes. The inconsistency of dyslipidemia might suggest that Palauan women might have different estrogen

changes from Filipino women, or the dyslipidemia related genotype frequency varies between Palauan and Filipino populations. Accordingly, the factors related to the disparity of dyslipidemia across ethnicity might be more complicated than those for obesity, hypertension, and diabetes.

Our findings demonstrated differences in the prevalence of metabolic risk factors of NCDs between the two major ethnic groups in Palau for the first time. While there have been several studies about NCD risk factors in Palau, no studies have yet shown the effects of Palauans' overweight or obesity on hypertension and diabetes. There are several limitations remaining in this study. First, this is a cross-sectional study, which may hardly to provide evidence of causality because of its nature. Second, the current study was a secondary data analysis: in other words, the original data collection was not designed for the current study, in which the number of Filipino participants included was small (20% of the studied sample). Moreover, we did not have enough number of obese Filipino subjects (BMI ≥30 kg/m^2, 18 men and 23 women) for further analyses stratified by BMI. Third, there might be residual confounding of unmeasured lifestyle related factors such as physical activity, total energy intake, and detailed nutrient intakes including sodium and fatty acids. Potential confounding caused by other unassessed demographic factors such as family structure and length of residence in Palau also could not be denied in this study. With the exception of the limitations mentioned above, our findings still could provide useful information on the differences of metabolic risk factors of NCDs between Palauan and Filipino residents in Palau. More precisely, obesity control and prevention in Palau would be urgently needed, which is also expected to result in a great reduction in Palauans' hypertension prevalence.

Palauans had a significantly higher prevalence of overweight or obesity compared with Filipinos. This would mainly explain the higher prevalence of hypertension and partially explain the higher prevalence of diabetes in Palauans. Metabolic risk factors of NCDs were not consistently more likely to be observed in native Palauans, namely Palauan men were less likely to be dyslipidemia compared with their Filipino counterparts.

ACKNOWLEDGEMENTS

The authors wish to express their deep gratitude to the Bureau of Public Health, Ministry of Health, Republic of Palau for the provision of the dataset. Appreciation is also given to its staff for the data collection. Data analysis of this paper is part of a joint research project between Palau and Japan, supported by the Health and Labour Sciences Research Grants for Research on Global Health Issues (H24-chikyukibo-ippan-004) to A.A. from the Ministry of Health, Labour and Welfare, Government of Japan.

DECLARATION OF CONFLICTING INTERESTS

The authors declare that there is no conflict of interest.

REFERENCES

1) The World Bank. Non-Communicable Disease (NCD) Roadmap Report. 2014, World Bank Group, Washington, DC. Available from: http://documents.worldbank.org/curated/en/2014/07/19778739/noncommunicabledisease-ncd-roadmap-report.
2) Appanaitis I. National Health Profile 2013. 2014, Office of Health Policy Research & Development, Republic of Palau, Ministry of Health, Koror. Available from: http://www.palauhealth.org/files/2013%20National%20Health%20Profile_%20Final%20121214.pdf.

3) Watson BM, Chiang C, Ikerdeu E, Yatsuya H, Honjo K, Mita T, *et al.* Profile of non-communicable disease risk factors among adults in the Republic of Palau: findings of a national STEPS survey. *Nagoya J Med Sci*, 2015; 77: 609–619.
4) WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, 2004; 363: 157–163.
5) Chalmers J, MacMahon S, Mancia G, Whitworth J, Beilin L, Hansson L, *et al.* 1999 World Health Organization-International Society of Hypertension Guidelines for the Management of Hypertension. *J Hypertens*, 1999; 17: 151–183.
6) World Health Organization. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia. 2006, World Health Organization, Geneva.
7) National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation*, 2002; 106: 3143–3421.
8) Witter T, Poudevigne M, Lambrick DM, Faulkner J, Lucero AA, Page R, *et al.* A conceptual framework for managing modifiable risk factors for cardiovascular diseases in Fiji. *Perspect Public Health*, 2015; 135: 75–84.
9) World Health Organization - Western Pacific & South-East Asia. Priority noncommunicable diseases and conditions. *In: Health in Asia and the Pacific*. pp.287–332, 2008, World Health Organization, Geneva.
10) Yanagisawa Y, Hasegawa K, Dever GJ, Otto CT, Sakuma M, Shibata S, *et al.* Uncoupling protein 3 and peroxisome proliferator-activated receptor gamma2 contribute to obesity and diabetes in Palauans. *Biochem Biophys Res Commun*, 2001; 281: 772–778.
11) Nakayama K, Lkhagvasuren M, Yanagisawa Y, Utsumi N, Kumada M, Gotoh T, *et al.* Comparative study of polymorphisms on genes associated with lifestyle related diseases in Asian and Pacific populations. *Asia Pac J Public Health*, 2008; 20 suppl: 173–179.
12) Brewis AA, McGarvey ST, Jones J, Swinburn BA. Perceptions of body size in Pacific Islanders. *Int J Obes Relat Metab Disord*, 1998; 22: 185–189.
13) Teevale T. Body image and its relation to obesity for Pacific minority ethnic groups in New Zealand: a critical analysis. *Pac Health Dialog*, 2011; 17: 33–53.
14) STEPS Country Reports. 2015, World Health Organization, Geneva. Available from: http://www.who.int/chp/steps/reports/en/.
15) Ralph E. Watson, Rudruidee Karnchanasorn, Ved V. Gossain. Hypertension in Asian / Pacific Island Americans. *J Clin Hypertens (Greenwich)*, 2009; 11: 148–152.
16) Klatsky AL, Tekawa IS, Armstrong MA. Cardiovascular risk factors among Asian Americans. *Public Health Rep*, 1996; 111 suppl 2: 62–64.
17) Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the Asian adult population: United States, 2004–2006. *Adv Data*, 2008; 394:1–22.
18) Wung SF, Aouizerat BE. Gender and ethnic differences in a case-control study of dyslipidemia: using the apolipoprotein A-V gene as an exemplar in cardiovascular genetics. *Res Theory Nurs Pract*, 2003; 17: 281–299.